

¹ Throughout this paper the term *fragment* is used to designate a portion of a chromosome resulting from one or more breaks in an original chromosome and having no spindle attachment. The term *chromosome* is applied to an original chromosome or the part of an original chromosome containing a spindle attachment.

² Carlson, J. G., *Genetics* (in press).

³ Mather, K., *Proc. Roy. Soc. London*, **B124**, 97-106 (1937).

⁴ Lillie, R. S., *Am. Jour. Physiol.*, **15**, 46-84 (1905); *Jour. Morph.*, **22**, 695-730 (1910).

⁵ Darlington, C. D., *Recent Advances in Cytology*, Philadelphia (1937).

⁶ Bělař, K., *Arch. Entw. u. Zool.*, **118**, 359-484 (1929).

⁷ Bělař, K., *Naturwiss.*, **15**, 725-734 (1927); *Zeit. Zellforsch. mikr. Anat.*, **10**, 73-134 (1930), **17**, 51-66 (1933).

⁸ Bleier, H., *La Cellule*, **40**, 85-144 (1930); *Genetica*, **13**, 27-76 (1931).

⁹ Schaefer, R., *Planta*, **8**, 383-397 (1929); *Beitr. Biol. Pflanzen*, **19**, 141-177 (1931).

¹⁰ Schrader, F., *Zeit. wiss. Zool.*, **142**, 520-539 (1932).

¹¹ Mather, K., and Stone, L. H. A., *Jour. Genetics*, **28**, 1-24 (1933).

¹² Upcott, M., *Proc. Roy. Soc. London*, **B124**, 336-361 (1937).

¹³ Schrader, F., *Zeit. wiss. Zool.*, **138**, 386-408 (1931); Hughes-Schrader, S., *Zeit. Zellforsch. mikr. Anat.*, **13**, 742-769 (1931).

¹⁴ McClintock, B., *Genetics*, **23**, 315-376 (1938).

¹⁵ Stadler, L. J., *Proc. Sixth Internat. Congress Genetics*, **1**, 274-294 (1932).

¹⁶ Helwig, E. R., *Jour. Morph.*, **55**, 265-311 (1933).

A TITANOTHERE FROM THE TYPE SESPE OF CALIFORNIA

BY CHESTER STOCK

DEPARTMENT OF GEOLOGICAL SCIENCES, CALIFORNIA INSTITUTE OF TECHNOLOGY

Communicated October 7, 1938

Introduction.—In previous papers,¹ published mostly in these PROCEEDINGS, have appeared some of the paleontological results of explorations conducted in the Sespe deposits of Southern California. While the field efforts south of the Santa Clara Valley, Ventura County, were rewarded by rather startling results, no small amount of irritation was felt because of failure to find fossil vertebrate remains in the Sespe at the type locality north of the Santa Clara Valley. For, as is now known, the Sespe is not of same age throughout its stratigraphic thickness or at the several localities where fossil mammals have been found in it. It is, in fact, a series of beds that range in age from at least the upper Eocene to apparently the lower Miocene. Thus it seems especially important to determine by means of vertebrate evidence the age relationships of the type Sespe on Sespe Creek to that portion of the Sespe whose age is already established south of the Santa Clara Valley.

With this problem in mind the rugged terrain north of the Ojai Valley,

Ventura County, and in the immediate vicinity of Sespe Gorge was critically examined during the summer of 1937 by a field party of the California Institute of Technology. The outcome of this work was the discovery of titanotheres remains in the lower portion of the Sespe, including a palate with teeth permitting a comparison with the titanotheres known from lower Tertiary horizons of southern California.

Geologic Occurrence.—The titanotheres remains were encountered in massive gray-brown to pink sandstones of the Sespe on Sespe Creek (Plate 1). These heavily bedded and well indurated strata are conformable to the sandstones and shales of the marine upper Eocene. The uppermost marine formation in contact with the Sespe has been recognized as the Coldwater on the basis of invertebrate fossils and stratigraphic position by F. E. Dreyer,² who, prior to the discovery of the vertebrate remains, had studied the geology of the region. Deformation and structural complications in the immediate vicinity of the fossil locality make it difficult to determine the exact position of the titanotheres remains in the Sespe above the contact with the Coldwater. However, it can be stated with some assurance that the location is not less than 400 feet nor more than 700 feet above the base of the Sespe.

DESCRIPTION OF MATERIAL

Teleodus cf. *californicus* Stock

Specimen.—A portion of a skull representing principally the palate with upper dentition, No. 2143 C. I. T. Vert. Pale. Coll., Plate 2, figs. A and B.

Locality.—C. I. T. Vert. Pale. Loc. 292, near north boundary of NE¹/₄, Sec. 2, R. 23 W., T. 5 N., San Bernardino B. & M., Mt. Pinos Quadrangle, Calif.

Comparisons.—The specimen, No. 2143, represents a mature individual in which the first molar and anterior premolars show considerable wear. The incisors and canines are likewise worn.

Two incisors are present on either side of the median line and these teeth possess the rounded, non-cingulate crowns seen in *Teleodus californicus*.³ The lateral incisor is larger than the medial one. The canines possess relatively small crowns. This tooth resembles the canine in *T. californicus*, but the crown is actually of smaller size. A slightly longer diastema is present in No. 2143 than in No. 1834 C. I. T. Vert. Pale. Coll., from the Sespe uppermost Eocene beds (C. I. T. Vert. Pale. Loc. 150) north of the Simi Valley. Unfortunately the premolars are considerably worn. *P*₁ is not present on the right side and but poorly preserved on the left. What remains of the tooth suggests a triangular shaped crown and a size like that in *T. californicus*. It is possible that *P*₁ was slightly larger in No. 2143 than in individuals from locality 150. Resemblance between the

latter species and the present specimen is seen likewise in the size and shape of the posterior premolars.

Comparison of the molars in No. 2143 with those of *T. californicus* from the Sespe north of the Simi Valley reveals again a close similarity between these two forms in size, shape and in details of structure of the tooth crowns. As in the latter species the hypocone is distinct in M_3 .

Comparing No. 2143 with a skull of *Teleodus uintensis*, No. 8634 Car-

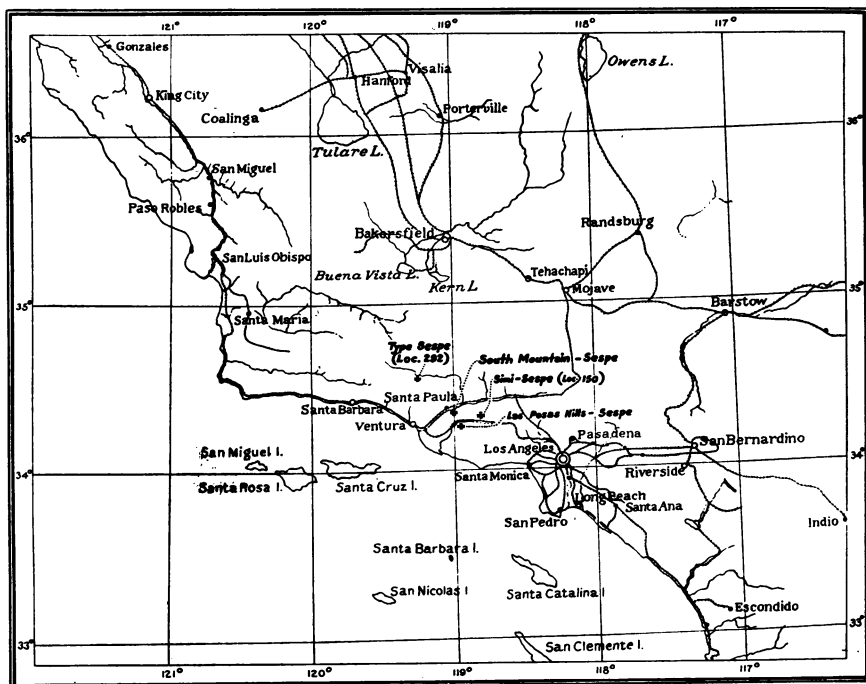


FIGURE 1

Index map showing location of principal vertebrate fossil occurrences in Sespe deposits of California. Note particularly position of localities 292 and 150.

negie Museum, from the Duchesne River formation of Utah, it is seen that certain differences in proportion exist between the two. Thus, while there is resemblance in width of snout across the canines and to some extent also in the length of the tooth-row, $C-M_3$ inclusive, the distance between the border of the maxillo-nasal notch and the anterior border of the orbit is shorter and the orbit is smaller in the California specimen.

No. 2143 is distinctly smaller than *Protitanops curryi* from the Titus Canyon formation, California. In the presence of larger incisors and in the shape of the anterior premolars the Sespe form is less advanced than the latter.

Conclusions.—A comparison of the titanotheres remains from locality 292 with those previously described from the Californian area suggests a close similarity in stage of evolution to *Teleodus californicus* from the Sespe north of the Simi Valley. The differences between these two forms may be established ultimately as of specific value but their importance on the basis of available material does not appear to be greater than that resulting from variation within a single specific group.

In the light of this similarity one may conclude that that portion of the Sespe in which locality 292 occurs north of the Santa Clara Valley is

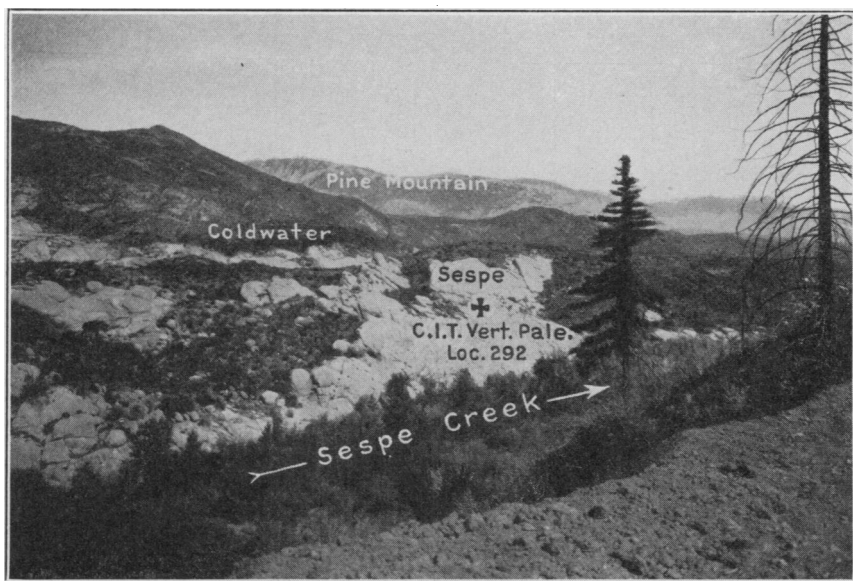


PLATE 1

View looking northeast across Sespe Creek showing typical exposure of heavily bedded sandstones of the Sespe continental beds resting on the Coldwater marine Eocene, and locality where titanotheres was found.

closely related in time to the stage of the Sespe containing the fauna found at locality 150 south of the Santa Clara Valley. The assemblage of fossil mammals found at the latter locality has been regarded as of uppermost Eocene age. Its relationships are with the Duchesne River fauna of Utah and its position in the faunal sequence of western North America is between the Uinta (Uinta C) upper Eocene and the White River lower Oligocene.

Underlying the Sespe in the region of locality 292 is the marine Coldwater and the latter has come to be regarded as upper Eocene in age. In fact, W. P. Woodring⁴ considers the Coldwater of the western Santa Ynez

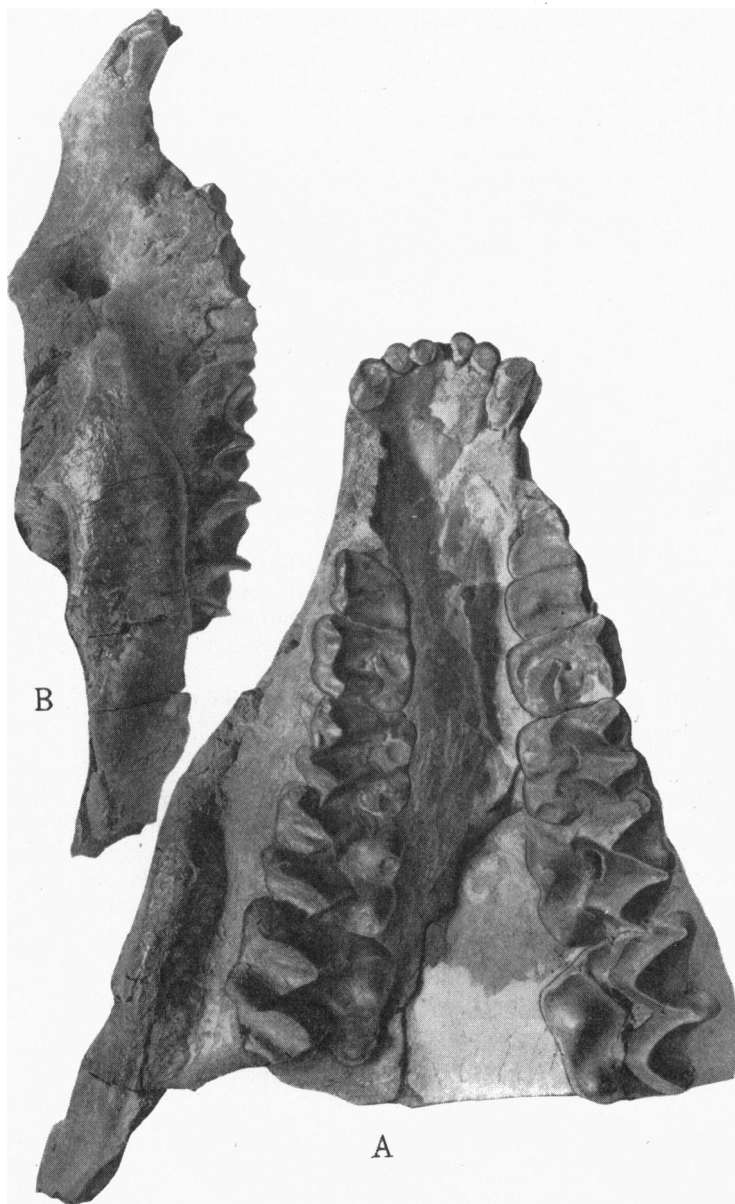


PLATE 2

Teleodus cf. californicus Stock

Figures A and B, skull fragment with upper dentition, No. 2143 C. I. T. Vert. Pale. Coll. figure A, $\times 1/3$; figure B, slightly smaller than $1/3$ natural size. Sespe Uppermost Eocene, California.

Range as representing the youngest Eocene faunal zone in California. Thus, the age determination of the Sespe at locality 292 as uppermost Eocene does not conflict with the evidence furnished by the marine invertebrates in the Coldwater and by the conformable relationship of the latter deposits to the Sespe. Since the Sespe is considerably thicker not far to the east of the section in which the titanotherium was found, it is reasonable to regard the age of these continental beds as extending from the uppermost Eocene into at least the Oligocene.

MEASUREMENTS (IN MILLIMETERS) OF No. 2143

| | |
|--|------------------------------------|
| Width measured across outer sides of canines | 68.8 |
| Length of diastema between <i>C</i> and <i>P</i> ₁ | 19 |
| Length from anterior end of <i>C</i> to posterior end of <i>M</i> ₃ | 283 |
| Medial incisor, width | 9.2 |
| Lateral incisor, width | 10.4 |
| Canine, width | 15.8; length 19 |
| <i>P</i> ₂ , transverse diameter | a25.5; length through middle a17.6 |
| <i>P</i> ₃ , transverse diameter | 31.7; length through middle 23.6 |
| <i>P</i> ₄ , transverse diameter | 41.9; length through middle 29.7 |
| <i>M</i> ₁ , transverse diameter | 45 ; length through middle 39 |
| <i>M</i> ₂ , transverse diameter | 55 ; length through middle 52 |
| <i>M</i> ₃ , transverse diameter | 61.7; length through middle 61.4 |
| Distance from anterior end of snout at point between medial incisors to anterior border of orbit | 164 |
| Depth of zygomatic arch immediately in back of postorbital process | 51.6 |
| <i>a</i> , approximate. | |

¹ Stock, C., see these PROCEEDINGS, 1932-1935.

² Dreyer, F. E., Thesis entitled: "The Geology of a Portion of Mt. Pinos Quadrangle, Ventura County, California," on file at University of California at Los Angeles.

³ Stock, C., *Proc. Nat. Acad. Sci.*, 21, 456-462 (1935).

⁴ Woodring, W. P., *Trans. San Diego Soc. Nat. Hist.*, 6, 386 (1931).

AUTOSOMAL LINKAGE IN MAN—THE RECOMBINATION RATIO BETWEEN CONGENITAL TOOTH DEFICIENCY AND HAIR COLOR¹

BY BARBARA S. BURKS

CARNEGIE INSTITUTION OF WASHINGTON, COLD SPRING HARBOR, LONG ISLAND

Communicated October 14, 1938

In the course of a search for linked traits, data have been obtained which establish for the first time a clear instance of autosomal linkage² in man, provide an estimate of the recombination ratio, and at the same time